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Abstract

Decisions' optimization in agriculture assumed, in general, choosing the most appropriate way to act in situations where management unit had no reliable data on variable factors, or in other words, when decisions must be taken under risk and uncertainties. In some agricultural holdings, a significant number of decisions were taken on empirical interpretation of the information circulating when designing decision, about the "state of nature", which often led to a poor-quality decisions, which could not generate optimal results in any case. Decision-making models did not create new information but had the great merit of transposing in an appropriate manner the existing one, systematically presenting a certain situation. With the help of some mathematical methods, based on this information, there could be defined the types of national behavior (for example, to minimize the largest loss that could occur if "nature" would manifest in the most hostile way), so that to choose the most appropriate strategy. In the present paper there was discussed the case in which the decisional matrix had an equilibrium point, the optional choice being made using criteria based on the circumstances and the level of hierarchy of the decision maker.

Keywords*:* Conditions, Decisions, Risk, Uncertainty

Introduction

Traditional Economics describes a static universe, but new realities and developments require the explanation of some changing situations. A social system that produces economic values is characterized primarily by uncertainty. Moreover, uncertainty and risk do not constitute an optional factor, but they are a defining aspect of the human condition. The purpose of rationality consists not only in avoiding the risk and eliminating uncertainty, as to adapt to risk an uncertainty, accepting situations as data.

In the economic units and in the agricultural ones in particular *(Negura, Gaburici and Dimulescu, 1975)*, a great number of decisions are taken under uncertainty. If the feasibilities of the state of nature are not known, decision making process occurs under uncertainty and the best version of mathematical hope can not be used as guidance in choosing.

To ensure the development of viable decision versions and the proper evaluation of each one, decision makers must show a high degree of competence, so that the results obtained from the

application of a version in practice (real consequences) to not differ from those evaluated in accepted proportions. The bigger the difference between real results and the assessed ones, the more it is required that within the shortest possible time to be initiated corrective decisions.

To solve an appropriate model, two stages are required: first, the examination of decision matrix (to see if it has an equilibrium point or not), and then choosing the solving criteria of decision matrix. The study presented in the paper analyzes the decision that is required to be taken regarding the issue of feed seeding in dual crop at a company within a complex agricultural holding.

Model Form

In model developing, the first phase is to build the matrix and the second phase is represented by the use of a table covered by certain methods of calculation, in order to reach optimal strategy.

Model's elements are:

▪ Available strategies, the alternatives of the decision center, which must be distinctly denoted by: $V_1, V_2, \ldots, V_i, \ldots, V_m$, $i = \overline{1,m}$;

▪ States of nature, denoted by $N_1, N_2, \ldots, N_j, \ldots, N_n$, $j = \overline{1,n}$, which can be favorable or unfavorable, in a greater or smaller measure

Placing in a table the m strategies on lines and the n states of nature on columns, and at the intersection box of rows with the columns the expected results, it is obtained the matrix.

Applying the appropriate decisions to allow the use of matrix for choosing the optimal strategy depends on the in formation we have regarding the probability of achieving the states of nature. The ability to predict the occurrence of N_j state depends on the state of knowledge of the system's uncontrollable factors, and also depends on a large number of precedents and heavy volume of data.

We consider that there are three possible *(V)* strategies:

V_1 - sowing the corn feed in double crop of an area of 250 ha;

V_2 - sowing the corn feed in double crop of an area of 125 ha;

V_3 - no double-seeded crop.

These strategies of the decision maker (head of the farm) can bring different economic results depending on the states of nature *(N)*. In this case, we consider as states of nature the weather forecast, given the amount of precipitation:

N_1 - There is a certain water supply in the soil and sufficient rain falls during the optimal sowing time;

N_2 – There is no water supply in the soil, but it rains enough during the optimal sowing time;

N_3 - There is no water supply in the soil, and does not rain during the optimal sowing time or after (drought);

N_4 – There is a water supply in the soil which is considered to be sufficient for the obtaining of crop even without any further precipitation after the sowing time (this requires the application of special works to maintain water in the soil).

N_5 – There is no water supply in the soil, it doesn't rain during the sowing time, but it rains in about 1-2 weeks of sowing.

By estimating corn feed production in double crop which can be obtained for each of the three strategies and five states of nature, it is made the consequences matrix. The consequences are expressed in thousands lei (RON) benefits or losses, and recorded for each case, at the intersection between the line which represents the strategy and the column which represents the state of nature.

Since we don't know which will be the states of nature at the moment of decision making regarding the sowing of the double crop, means that we have to take a decision under uncertainty.

Table 1. The values correspond to those 3 strategies and to those 5 states of nature

	N_1	N_2	N_3	N_4	N_5
V_1 [250 ha]	100	80	-70	65	55
V_2 [125 ha]	55	30	-43	30	20
V_3 [0 ha]	-45	-33	-25	0	-20

We will use the five rules of decision *(Albici, Teselios, Tenovici, 2010)*:

a) **Prudence criterion (the rule of Abraham Wald)**. Applying this criterion to the given matrix, we obtain:

$$\max\{\min\{100,80,-70,65,55\},\min\{55,30,-43,30,20\},\min\{-45,-33,-25,0,-20\}\}=$$

$$=\max\{-70,-43,-45\}=-43 \Rightarrow V^* = V_2$$

b) **Optimistic criterion:** It is preferred the version which leads to the highest payment throughout the matrix, regardless of negative consequences that might occur. According to the formula we get:

$$\max\{100,55,0\}=100 \Rightarrow V^* = V_1$$

We notice that the V_1 version allows the obtaining of a maximum benefit of 100 thousand lei for the state N_1 of nature, but may be resulting in the greatest loss (- 70 thousand lei) if the state of nature N_3 will occur (there will be drought).

c) **Weighted optimism criterion:** Considering $\alpha = 0,5$ as a social medium value of the optimistic degree results:

$$\max\{[0,5\cdot100+0,5\cdot(-70)];[0,5\cdot55+0,5\cdot(-43)];[0,5\cdot0+0,5\cdot(-45)]\}=$$

$$=\max\{(50-35);(27,5-21,5);(0-22,5)\}=$$

$$=\max\{15;6;-22,5\}=15 \Rightarrow V^* = V_1$$

d) **Minimum regret criterion (Savage):** The Savage Method requires the calculation of regrets' matrix:

$$R_{ij} = \begin{pmatrix} 0 & 0 & 45 & 0 & 0 \\ 45 & 50 & 18 & 35 & 35 \\ 145 & 113 & 0 & 65 & 70 \end{pmatrix}$$

And will minimize the largest anticipated regret:

$$\min\{\max\{0,0,45,0,0\}; \max\{45,50,18,35,35\}; \max\{145,113,0,65,70\}\} =$$

$$= \min\{45;50;145\} = 45 \Rightarrow V^* = V_2$$

e) **Laplace criterion**. We obtain:

$$\max\left\{\frac{100+80-70+65+55}{5}; \frac{55+30-43+30+20}{5}; \frac{-45-33-25+0-20}{5}\right\} =$$

$$= \max\left\{\frac{230}{5}; \frac{92}{5}; \frac{-123}{5}\right\} = \frac{230}{5} \Rightarrow V^* = V_1$$

We notice that the V_3 version is not approved by any criteria and thus is out of the question. It remains to be decided between the alternatives V_1 and V_2.

While the majority rule may not be relevant in such matters, the V_1 version can still be proposed for implementation.

In case in which analyzing statistical data of past periods involves determining probability of states N_1, N_2, N_3, N_4, N_5 as follows:

$p(N_1) = 0,25$;

$p(N_2) = 0,2$;

$p(N_3) = 0,15$

$p(N_4) = 0,3$;

$p(N_5) = 0,25$,

Choosing the optimal version will be made by using mathematical expectancy. Mathematical expectancy of some economic activities' results is the average weighted size of the activity results, the weights being equal to the events' probabilities or states of nature.

In case of a V_i version of solving a problem, characterized by random events, these are featured by x_j, the probability of their production $p(x_j)$ and the obtained results r_{ij}, mathematical expectancy of results in V_i version denoted $S(V_i)$, will be given by the formula:

$$S(V_i) = \sum_j r_{ij} p(x_j), \quad i = \overline{1,m}, \quad p_i(x_j) \in [0,1], \quad \sum_j p(x_j) = 1.$$

If there are economic effects expressed by r_{ij} results, then the optimal value will be the one that satisfies the condition:

$$\max_i \left\{ S\left(V_i \right) \right\} \Rightarrow V_i^*$$

Thus:

$$S\left(V_1 \right) = 0,25 \cdot 100 + 0,2 \cdot 80 - 0,15 \cdot 70 + 0,3 \cdot 65 + 0,25 \cdot 55 =$$
$$= 25 + 16 - 10,5 + 19,5 + 13,75 = 63,75 \ \text{Thousands lei}$$
$$S\left(V_2 \right) = 0,25 \cdot 55 + 0,2 \cdot 30 - 0,15 \cdot 43 + 0,3 \cdot 30 + 0,25 \cdot 20 =$$
$$= 13,75 + 6 - 6,45 + 9 + 5 = 27,3 \ \text{Thousands lei}$$
$$S\left(V_3 \right) = -0,25 \cdot 45 - 0,2 \cdot 33 - 0,15 \cdot 25 + 0,3 \cdot 0 - 0,25 \cdot 20 =$$
$$= -11,25 - 6,6 - 3,75 + 0 - 5 = -26,6 \ \text{Thousands lei}$$

It is therefore recommended to be chosen the V_1 version. This corresponds to the appliance of the condition of the three mathematical expectation calculated above in order to be maximum.

Conclusions

The essential purpose of solving problems must ensure consistency between performances levels and the possibilities of superior capitalization of the available resources. Optimization activity of relations between decision maker's objectives and the existing resources must be addressed sequentially, starting with the branches of production, crop structure and livestock and ending with the sale of agricultural products. Economic-mathematical models as knowledge tools *(Raţiu-Suciu, 1995),* used in the preparation of decisional versions, will have to capture the whole complex of factors and the interactions between them, so that, by applying the decision version, the actual results to not differ from the evaluated ones.

Given the large number of decision problems that are addressed in terms of risk and uncertainty, the use of specific methods of substantiating decisions will contribute to the improvement of decision process in economic units.

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